THE DESCRIPTION

Of a Plain

INSTRUMENT,

THAT

With much eaſe and exactneſs will diſcover the ſituation of any vertical Plane, howſoever inclining, reclining, or declining,

AND

How to draw a DYAL upon any ſuch Plane, or upon the face of any vertical body, how irregular ſoever,

TOGETHER

With ſeveral other things requiſite to the ART of

DYALING.

By *A. M.*

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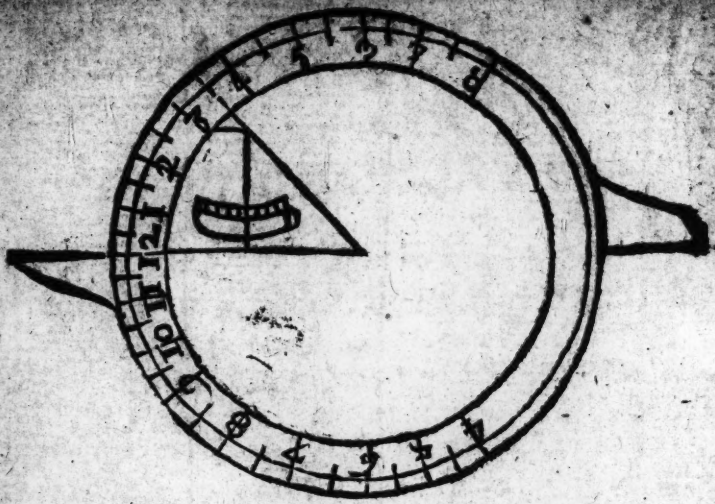

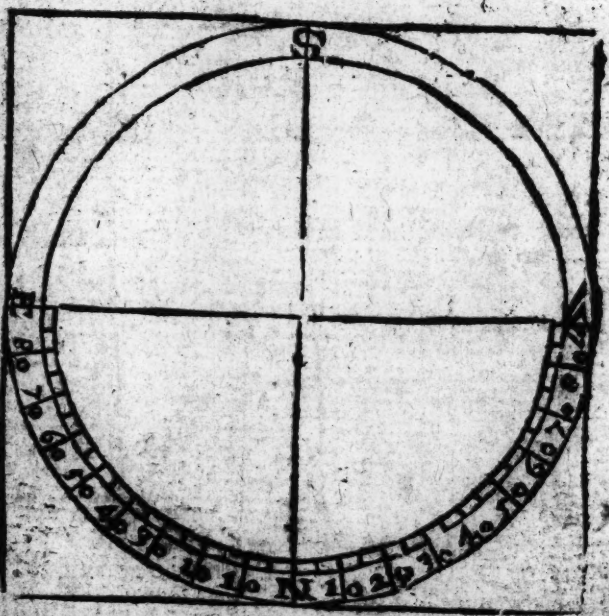
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The Deſcription of a plain Inſtrument, that with much eaſe and exactneſs will diſcover the ſituation of any vertical plane howſoever inclining, reclining, or declining; and how to draw a Dyal upon any ſuch plane, or upon the face of any vertical body how irregular ſoever, together with ſeveral other things requiſite to the Art of Dyalling.

THe Inſtrument conſiſts of two main parts, a Baſis and a Dyal.

The Baſis may be a plate of Braſs, or a piece of wood ſmooth wrought, and of one thickneſs throughout, perfectly ſquare, and divided into 4 little ſquares, by 2 right lines, cutting each other

at right Angles in the preciſe middle, one being marked with *W. E.* for Weſt and Eaſt, and the other with *N. S.* for the North and South; which latter line repreſenteth the Meridian when the Dyal ſtands in its moſt natural poſition; but its more ordinary uſe will be to repreſent the Axis of the plane.

Upon the interſection of theſe two lines, as upon a Centre, muſt be deſcribed one circle or more; two quadrants whereof from ℵ. both ways are to be divided into degrees (if not ſmaller parts) and diſtinguiſhed by Figures, as the degrees of quadrants uſually are.

The edge of the Baſis noted with ℵ, I ſhall for diſtinctions ſake, call the fiducial edge.

So much for the Baſis: The Dyal is a perfect horizontal one, fitted to the latitude of the place where 'tis preſumed it will be moſt uſed, The Plate of the Dyal exactly circular, and having the ſame common Centre with the Hour circle, and the utmoſt edge of the Dyal-plate almoſt touching the circle of the Baſis, whereof 2 quadrants were divided, as aforeſaid.

Through the Centre of the Dyal is a ſmal Pin driven, or ſcrewed into the Baſis at the Centre, faſtning the Dyal to the Baſis, yet ſo as it may turn about ſomewhat ſtraitly; and another Pin ſo contrived as to fix the Dyal at pleaſure in any poſition; from the former of which Pins a threed of of ſtrong ſilk iſſueth at the Centre of the Dyal.

Upon

Upon ſome convenient place of the Gnomon is a line drawn perpendicular to the Dyal-plate, with a thred and plummet fitted to it, and falling upon a large Arch of a Circle, divided both ways from the ſaid line into degrees and parts, for ſhewing the inclination and reclination of Planes: And at the lower edge of the Gnomon, the North end hath a ſharp point or Index, and another at the oppoſite end of the Meridian line I ſhall call the Counter-Index, ſerving to point out declinations.

It is convenient to have the uppe edge of the Gnomon long, and when the inſtrument muſt be placed far from the plane (as in ſome caſes it will fall out) it is good to lengthen out the Gnomon and hour-lines in the operation, by applying thereunto a fine ſtreight rule; and the ſame courſe will be convenient when the Inſtrument is a very little one.

There is beſides belonging to it a plate and a needle: The plate may be of fine thin braſs, or tin-plate ſmooth and purely flat, cut at right Angles, of the form of an Octavo leaf, but ſomewhat longer, with a long notch towards the middle cut out, about the length of the third part of the Diameter of the Dyal, or ſcarce ſo much, and of what depth you pleaſe, provided it be deep enough to give way, that the notched edge may touch the line of VI without diſturbance from the Pin in the Centre of the Dyal.

The needle muſt be hafted and framed much after the faſhion of a Shoemakers ſmall Awl, but longer and more bowed, with a little ſtreight point, having an eye in it like a Sadlers bodkin.

The uſe of the aforeſaid Inſtrument.

1. To draw an horizontal line,

Fix the Diall on the Baſis with the Index upon either of the croſs lines, then turning the Inſtrument with the graduated ſide of the Gnomon towards you, ſet the oppoſite edge to the plane, and holding it ſo as the thred playing at liberty, fal directly on the perpendicular line: you may by the edge of the Inſtrunent touching the plane, draw an horizontal, or level line.

2. To draw a perpendicular line

Draw firſt an Horizontal line, and laying the back ſide of theInſtrument or the plate cloſe to the plane till the upper edge touch that line, all along you ſhall have 2 edges to guide you at your choice, to draw a perpendicular line.

3. To draw a meridian line.

Fix the Inſtrument Horizontally, and ſet the Diall to the true hour of the day, then will the thred laid upon the meridian line of the Diall, and extended at pleaſure, give you a meridian line upon any Horizontal plane that it can touch, and by the help of a thred and plummet upon any plane above or below the extended thred.

4. To

4. To find the Suns Azimuth.

Fix the Diall upon the Basis, with the Index standing over the line *N. S.* at *N.* Then turning about the whole Instrument, till standing Horizontally, it give you the true time of the day, (which you must first know by some good double ring-diall or otherwise) fix the Basis also to some stable thing by nailes driven through holes made in the Angles thereof to that purpose, and drawing up perpendicularly so much of your thred at the centre of the Diall, as will suffice to cast the shadow upon the circle of the Basis: the degree or part cut by that shadow, is the Azimuth from the South, and its complement to a quadrant the Azimuth from East or West: but if the shadow of the thred, fall not upon either of the divided quadrants, but nearer towards the letter *S.* then turn about the Diall (the basis remaining fixed till the Index stand upon the line *W. E.* at *E.* or *W.* as occasion is: that is at *E.* in the morning, at *W.* in the evening, then will the shadow give you the Sun's Azimuth from the East or West point, and that added to 90 degrees is his Azimuth from the South, and subducted from 90 degrees, it gives his Azimuth from the North.

5. To find the Suns altitude or Almicantar.

Let the Index be placed over one of the great cross lines of the Basis, and a line drawn upon the Gnomon, meeting the perpendicular at right angles in the Centre or hole for the thred. Then

holding that edge to which the Index looketh, horizontally, and erecting a pin perpendiculatly in the ſaid hole, hold up or depreſs the oppoſite edge till the ſhadow of the ſaid pin run along the line, then will the thred, playing at liberty, fall upon the degrees and parts of the Suns height above the horizon.

6. To find the unknown latitude of a place, the hour being given.

Draw a Meridian line by the rules of Art, as Mathematicians teach (which are too long to be here recited) Then placing the Meridian of the Dyal upon the Meridian ſo drawn, and lifting up the South or North end of the Dyal (Baſis and all, except you have taken the Dyal off from the Baſis) till the ſhadow give you the true time of the day, the thred will ſhew how many degrees, and parts the latitude of the place where your work is to be performed, is more or leſs than the known latitude of that place for which the Dyal was projected; but for this purpoſe the Dyal ſhould be large, and the time of the day a great ſpace from noon.

7. To find the inclination or reclination of a plane.

Apply the plate to the plain flat ſide of the Gnomon, or ſtile, ſo as the long edge may reſt upon the Dyal-plate, and the ſhort edge reach juſt to the edge of the Baſis, towards which the Index pointeth, ſtanding upon one of the croſs lines of the Baſis; Then having drawn an horizontal line

upon

upon the plane, apply thereunto the edge of the Baſis, with the plate ſo plac'd upon it in ſuch ſort, as that the ſhort edge of the plate may reſt all along upon the plane. Then will the thred playing at liberty, ſhew upon the other ſide of the Style the degrees and parts of Inclination or reclination, *viz.* of inclination when the thred falleth between the perpendicular line and centre of the Dyal; of reclination when the ſaid thred falleth between the perpendicular line and the Index. The quantity of the Angle being ever reckoned from the perpendicular to the place cut by the thred.

8, To find the declination of a Plane.

" Apply the fiducial edge of the Baſis, with the Index ſet towards it, upon the line *N. S.* to an horizontal line drawn upon the plane, ſo as the Plummet hanging at liberty, the thred will fall upon the perpendicular line (the Dyal being fitted to the latitude of the place where it is to be uſed) then turning about the Dyal, till (by the Sun ſhining upon it) it ſhew the right time of the day: and upon one of the divided quadrants you ſhall find either the Index pointing out the declination of the Axis of the plane, from the South towards the Eaſt or Weſt; or the counter-Index ſhewing the declination from North, towards the Eaſt or Weſt: always reckoning the degrees and parts from *N.* where the degrees begin.

A caution.

If your Diall be for another latitude, conſide-

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rably differing: you muſt both in this, and the following caſes, ſo hold your Inſtrument, that upon the Arch on the Gnomon, ſo many degrees and parts may be cut by the threed, from the perpendicular line towards the index, as the latitude of the place for which the Diall was made, is greater then that where it is uſed: or contrarily ſo many degrees and parts from the perpendicular line towards the centre of the Diall, as the latitude for which the Diall was drawn is leſs then of the place where you make uſe of it; This caution is ever to be underſtood when I ſpeak of placing the Inſtrument Horizontally.

9. To draw a true Dial ſpeedily, without skill in the Mathematicks, upon any erect plain, or irregular face of a body, being ſituate more Southerly, than the Eaſt or Weſt points, *viz.* when the Index ſhewes the declination.

Place the Inſtrument Horizontally upon a Table, or ſome other ſtable thing: and having fixed the Baſis, turn about the Diall to the true time of the day, and fix it alſo by the pin made for that purpoſe; then drawing out the thred at the centre of the Dyall ſtreight along the upper edge of the Gnomon, till it touch the place where the dyall muſt be made: the point ſo touched by the thred, ſhall be the centre of your Dyall, and the thred drawn out ſtraight ſhews the Angle and forme of the Gnomon: then lay the thred upon all the hours, half-hours and quarters, which the plane

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or other face, will receive, and drawing the thred out ſtreight, and perfectly even with the Dyall-plate, till it touch the plain or other face, make points where it toucheth, by which and the centre of the Dyall, you may draw all the hour lines, and mark out the half-hours and quarters.

Here once for all note theſe 3 things

1. That i'ts good to try, before you fix the Inſtrument, where the centre of the Dyall will be, removing the Inſtrument backward, and forward, till the thred hit where you would have it; and if by this means the Inſtrument ſtand far off from your work, you may by a ruler or plate laid even, (ſo far as you can apply it) with the edg of the ſtyle guide the thred more perfectly; The ſame courſe is to be held, when the Inſtrment is very ſmall.

2. If you draw out the thred at the centre of the Dyall, along the meridian line, ſtraight over the *I*ndex till it touch the plane, it will give you a point, by which and the centre of the Dyall, you may draw a line which ſhall be your ſubſtyle, where the foot of your ſtyle or Gnomon muſt ſtand.

3 If you apply the long edge of the plate to the ſubſtyle, and lay the flat ſide to the thred drawn out ſtraight from the centre of the Dyall, along the upper edge of the Gnomon, till it touch the plane in the centre for the new Dyall as aforeſaid,

ſaid, you may by your pen, pencil, or the like, make 2 or more points where the thred toucheth, and by the help thereof draw a line, which, together with the edge applyed to the ſubſtyle, giveth you the perfect Angle and form of the Gnomon upon a fixed thing, which will guide a Workman far better than the thred to make the Gnomon, and by this means the pattern may be ſent any whither.

10. To draw a true Dyal ſpeedily upon any erect plane ſituated more Northerly than the Eaſt or Weſt point, *viz.* when the Counter-Index ſhews the declination.

Turn the Index to the place where the Counter-Index ſtood when you took the declination; then going to the other ſide of the open wall or building, find a place where that declination fits, that is, where the Dyal ſtanding as aforeſaid, and the fiducial edge of the inſtrument applyed to the plane horizontally, the Gnomon ſhews the true time of the day, by the ſhadow; and if that prove difficult, you may by a door moved upon its hinges, or reared up in a due poſition, relieve your ſelf: Upon the place found, pin a large ſheet of Paſt-board, or Paper-Royal, ſtreight and even, and thereon draw a Dyal, as was laſt directed, for a Southerly plane. Then take it down, and pricking it through, draw ſo many of the lines as the Sun in the longeſt dayes will ſhine on, upon the back-ſide, which being placed on your Northerly

plane,

plane, with the Centre downwards, in a perpendicular line directly under the point, which on the other ſide would have ſtood for 12 of the clock, will be a perfect pattern to draw a Dyal on it, whoſe lines you may extend or ſhorten at your pleaſure, as beſt fits your plane.

11. To draw a Meridian Dyal upon an Eaſt or Weſt plane.

When you are taking the declination of a plane, if the Index and Counter-Index ſtand upon the line *E. W.* It is a meridian plane, whoſe Axis is true Eaſt or Weſt, according to the letter pointed at by the Index. Now to draw a Dyal on ſuch a plane, place the inſtrument horizontally, the fidncial edge touching the plane. Then laying the thred upon all the hour-lines and half-hours that the plane will receive, draw forth the thred ſtreight to the plane, and mark the points where the thred toucheth (which may be beſt done if the Dyal ſtand cloſe to the plane, by help of the needle before deſcribed) for if you put the thred through the eye thereof, and hold it ſtreight, the ſtreight end will help you to mark the points exactly, and the crooked part riſing upward will give way to your eye, to ſee whether the thred lie right upon the hour-lines, &c. Then laying your plate flat upon the upper edge of the Gnomon, the long edge of the plate reſting all along upon the line VI. the ſhorter touching the plane, will be your guide to draw the ſubſtyle, which by a ruler you may extend

extend at pleasure; Then removing your instrument a little higher or lower (it matters not whether, so that it stand again horizontally close to the plane, and so as the plate will again fall into the substylar line) mark points for hours as aforesaid, by which points and the former, lines may be drawn parallel to the substyle, which must be marked with the same numbers with the hours on your Dyal-plate, that guided you to them.

But here also it is good to note diverse things.

1. Your style must be a pin with a sharp point, or else a parallel plate set up perpendicularly in the substyle, just so high as may reach the hour-line of 9 in an Eastern Dyal, and 3 in a Western.

2. If you have the Art of drawing parallel lines either Geometrically, or by help of the plate (which will supply the place of a square) you may spare the second application of the Instrument to the plane.

3. If the plane be high and inconvenient for the fixing of your Instrument close to it, you may pin a Past-board or paper upon any Wall, as if that were a true meridian Wall, and draw a Dyal upon it (having first observed in the fixing of your Instrument, that the Index stand as it did when you took the declination, and the fiducial edge be applyed to the plane) Then striking a perpendicular, or horizontal line quite through your paper,

draw

draw the like line upon the plane where the Dyal ſhould be drawn, and placing the perpendicular or horizontal line, which is on the Paſt-board or paper, upon that which is drawn on the plane, you may prick two points through every line in the paper, and thereby draw them upon the plane.

4. If you would make a larger Dyal than the Inſtrument ſet cloſe will give you, you may do it by ſetting the Inſtrument further off; but then if you know not how to draw parallel lines, without a ſecond application of the Inſtrument, you muſt be ſure to ſet it juſt at the ſame diſtance from the plane at both applications; to which purpoſe it will be convenient to interpoſe a parallel piece of wood truly wrought; but to make a leſs Dyal of this ſort, you muſt have a leſs Inſtrument, or elſe by taking the Dyal off the Baſis, you may apply it cloſer, or make uſe of a ſmall horizontal Dyal, which indeed will do this work (and ſome of the other) as well as the Inſtrument.

5. The Line of VI. and the ſubſtyle are the ſame.

6. You may make the Dyal of what ſhape you pleaſe, as round, ſquare, oval, or in the form of an heart, *&c.* but a long ſquare is moſt uſual: Nor doth it matter how long or ſhort the hour-lines be, provided they run ſtreight on ſo far as they go.

12. To draw an Horizontal Dyal upon its own plane.

This is ſo eaſie that I thought to have omitted

it, for if you place the Inſtrument upon it, and turning the Dyal to the true hour of the day, there fix it, the thred laid upon the ſeveral hours, half hours, and quarters, will transfer them to the plane, and lines drawn from the oppoſite hours of the ſame number, will meet in the centre, and the Gnomon of the Dyal gives the pattern of the Gnomon of the other which muſt be placed in the meridian line (which I ſhewed before how to draw) to the centre of the new Dyal.

The Inſtrument may be made uſe of for drawing of reflecting Dyals, and many other curioſities, but the performance preſuppoſeth more skill than I can preſume to be in them for whom this contrivance is principally intended.

IF any one deſire to be furniſhed with the Inſtrument herein deſcribed, he may make uſe of Mr. Edward Fage *in* Hoſier-Lane, *at the Sign of the Sugar-Loaf, Mathematical Inſtrument-Maker, or Mr.* William Newton *of* Fulſhaw, *living in* Mancheſter, *in* Lancaſhire; *who will make it either in Braſs or Wood exactly, and at a reaſonable rate.*

Any that hath but ſo much (or rather little) skil in Geometry as to meaſure Angles, he may make uſe of an horizontal Dyal only, with a thred at the Centre.

FINIS.